Graduation Project Summary

My graduation project focused on the design and implementation of an Automatic Nuts Filling and Sealing Machine an automated system developed to provide a low-cost packaging solution for small and medium-sized businesses.

The project aimed to improve packaging efficiency, increase weighing accuracy, and reduce the manual effort required in traditional nut packaging processes.

The system integrates mechanical, electronic, and software components into a single machine capable of performing the main packaging stages: dispensing nuts, measuring weight, releasing the required quantity into a bag, and sealing the bag. The design was developed with scalability in mind, allowing future expansion into a fully automated industrial packaging system.

The machine consists of several major subsystems the feeding subsystem uses a vibration motor to control the flow of nuts from a hopper. The weighing subsystem utilizes a Load Cell and an HX711 amplifier to measure the product weight accurately. The control subsystem, built around an Arduino Mega, acts as the central controller, processing sensor data and coordinating all machine operations. Finally, the sealing subsystem uses a heat-sealing mechanism to securely close the packaging bags after filling.

The software was developed using C++ in the Arduino IDE. The control program continuously monitors the measured weight, activates the vibration motor while filling, and automatically stops the feeding process once the target weight is reached. The system then opens a mechanical gate to release the nuts into the bag and activates the sealing mechanism after confirming the bag is correctly positioned.

To enhance functionality and reliability, several hardware components were integrated, including an LCD display for system status monitoring, laser sensors for bag detection, a NEMA 17 stepper motor controlled through a TB6600 driver for mechanical movement, and multiple servo motors for gate control. Separate 5V and 12V power supplies were implemented to ensure stable operation of electronic and mechanical components. Relays, transistors, and proper electrical isolation

techniques were also employed to safely control high-current devices and protect the control circuitry.

Extensive testing was performed to evaluate weight accuracy, feeding consistency, and sealing quality. The results demonstrated that the machine achieved satisfactory performance and acceptable accuracy for small-scale packaging applications. Minor variations were observed due to differences in nut size and the nature of vibration-based feeding, but overall system reliability remained high. Safety considerations were addressed through electrical insulation, proper power distribution, and the use of heat-resistant materials around the sealing unit.

Despite challenges such as budget limitations, manual bag placement, and the use of non-industrial-grade components, the project successfully achieved its primary objectives. It demonstrated the practical application of embedded systems, automation, sensor integration, motor control, and hardware-software interaction. Furthermore, the project provides a solid foundation for future improvements, including automatic bag feeding, advanced temperature control, increased production speed, and enhanced industrial-grade reliability.